Chapter 17. Pollution Prevention

Pollution prevention can improve water quality for all beneficial uses by protecting water at its source and therefore reducing the need and cost for other water management and treatment options. An important pollution prevention strategy is implementation of proper land use management practices to prevent elevated sediment loads and other pollutants from entering the source water. By preventing pollution, restoring and then protecting improved water quality throughout a watershed, water supplies can be used, and reused, for broader numbers and types of downstream water uses. Improving water quality by protecting source water is consistent with a watershed management approach to water resources problems. In addition, as increasing emphasis is placed on protecting in-stream uses – fish, wildlife, recreation and scenic enjoyment – surface water allocations are administered under ever-tightening restrictions, posing new challenges and giving new direction to the State Water Resource Control Board's water right activities. Under the public trust doctrine, certain resources are held to be the property of all citizens and subject to continuing supervision by the State. Originally, the public trust was limited to commerce, navigation and fisheries, but over the years the courts have broadened the definition to include recreational and other ecological values.

In a landmark case, the California Supreme Court held that California water law is an integration of both public trust and appropriative right systems, and that all appropriations may be subject to review if "changing circumstances" warrant their reconsideration and reallocation. At the same time, it held that like other uses, public trust values are subject to the reasonable and beneficial use provisions of the California Constitution. Together with the State Water Board, the courts have concurrent jurisdiction in this area.

The difficulty comes in balancing the potential value of a proposed or existing water diversion with the impact it may have on the public trust. After carefully weighing the issues and arriving at a determination, the Board is charged with implementing the action which would protect the latter. The courts also have concurrent jurisdiction in this area.

As with all the other pieces of the California water puzzle, protecting through pollution prevention, restoring/improving impaired water quality, and allocating the limited resource fairly and impartially among many competing users are among some of the State Water Board's greatest challenges.

Status of Pollution Prevention in California

In the past, our main water pollution focus was primarily on those from point source discharges. Pollution can enter a water body from point sources like wastewater treatment facilities, industrial, construction, or municipal discharges from storm water runoff. In recent years, however, as point sources have been more effectively regulated and controlled, the remaining so-called "non-point sources" (NPS) of pollution have become one of the main concerns of the State and Regional Water Boards. These NPS pollutants are generated from a variety of sources, including land use activities associated with agricultural operations and livestock grazing, forestry (silviculture) practices, uncontrolled urban runoff from development activities, deposition of airborne pollutants (i.e.: mercury), hydromodification, and discharges from marinas and recreational boating activities. There are many approaches—regulatory (e.g., dischargers

under the Water Code), voluntary/self-determined (e.g., locally led entities that desire a cleaner environment and that conduct riparian and ecosystem restoration activities), or incentive-based (e.g., USDA-NRCS-EQIP-National Water Quality Initiatives funding for implementing Agriculturally based Management Practices)—available for preventing water pollution, particularly NPS pollution. Understanding, planning for, assessing, documenting, managing, and controlling NPS pollution through better land use management is a relatively new focus, and tools for this will continue to be developed.

The US Environmental Protection Agency (USEPA), State Water Resources Control Board (State Water Board), California Coastal Commission (CCC), and Regional Water Quality Control Boards (Regional Water Boards) coordinate closely on NPS pollution issues. These agencies implement permitting, enforcement, remediation, monitoring, and watershed-based programs to prevent pollution. In addition, as part of the State of California's NPS Program Fifteen-Year Strategy (NPS Program Strategy), begun in 1998, the State Water Board established an Interagency Coordinating Committee (IACC) to assist more than 20 other State agencies with NPS regulatory authorities and/or land use responsibilities to familiarize themselves with each others' NPS activities, and to better leverage their resources. The Irrigated Lands Regulatory Program Roundtables and the Marina's IACC meetings continue to be two of the most effective of these originally formed groups.

NPS dischargers are responsible for ensuring that their discharges do not adversely impact the quality of waters of the State. In an effort to prevent pollution, restore impaired water quality or to protect improved waters, the State Water Board funds many water quality projects in the state with bond funded grants and loans and federal Clean Water Act (CWA) section 319 (CWA 319) implementation and planning/assessment grants. These grant and loan funded projects can provide additional information about discharge types, impacts to water quality, and management practices that could possibly minimize these impacts. However, unless additional water bond funds are proposed in the coming years, these bond funds will eventually be depleted, with only the CWA 319 implementation and planning/assessment grants continuing through the State Water Board. The amount of funding made available to the State Water Board for the NPS program, through the federal CWA 319, has declined within recent years (13% in 2010 and 10% in 2011)., The expectation is for these reductions to continue in the future. Although these reductions in funding have not changed the amount of grant funding for the planning/assessment and implementation projects, it has caused a reduction in the amount of NPS staff time available to work to prevent NPS pollution, and improve and restore water quality. The need for increased CWA 319 funding and improved collaboration, cooperation and leveraging of all funding sources will be of extreme importance in order to sustain a high level of water quality improvement and restoration efforts. The State Water Board NPS Program has identified watershed-based plan development and funding coordination for planning/assessment and implementation as a high priority.

Antidegradation Policy

The CWA requires each state to adopt a statewide antidegradation policy and establish procedures for its implementation. The State and federal antidegradation policies require, in part, that where surface waters are of higher quality than necessary to protect beneficial uses (e.g., designated uses of the water which can include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves), the high quality of those waters must be maintained unless otherwise provided for by the policies. The federal antidegradation policy prohibits any activity or

discharge that would lower the quality of surface water that does not have assimilative capacity, with limited exceptions. The State's Antidegradation Policy, which pre-dates the federal Clean Water Act, was adopted by the State Water Board in 1968 as State Water Board Resolution No. 68-16. SWRCB Resolution 68-16 establishes the requirement that state water discharges be regulated to achieve the "highest water quality consistent with maximum benefit to the people of the state." The State's Antidegradation Policy applies more comprehensively to water quality changes than the federal policy because it also applies to groundwater, not just surface water.

The Antidegradation Policy has been incorporated into all Regional Water Boards' Water Quality Control Plans (Basin Plans). A Basin Plan establishes a comprehensive program of actions designed to preserve, enhance, and restore water quality in all water bodies within the State of California. The Basin Plan is each Regional Water Board's master water quality control planning document. It designates existing and potential beneficial uses of surface water and groundwater and water quality objectives that protect those uses. Title 40, Part 131 of the Code of Federal Regulations requires each state to adopt water quality standards by designating beneficial uses to be protected and promulgating water quality criteria that protect the designated uses. In California, the beneficial uses and water quality objectives are the State's water quality standards.

The State Water Board uses the precautionary principle approach in many of its ongoing programs, particularly those that involve environmental justice issues. According to this approach, when an activity raises threats to the environment or human health, precautionary measures are taken even if some cause and effect relationships are not fully established. Key elements of the principle include exercising precaution in the face of scientific uncertainty; exploring alternatives to possibly harmful actions; placing the burden of proof on proponents of an activity rather than on victims or potential victims of the activity; and using democratic processes to carry out and enforce the principle – including the public right to informed consent.

Total Maximum Daily Loads (TMDLs)

The CWA Section 305(b) requires each state to report biennially on the quality and condition of its waters. CWA Section 303(d)(1)(A) requires each state to identify waters within its boundaries which are not meeting water quality standards. The reports submitted by states serve as the basis for EPA's National Water Quality Inventory Report to Congress. The State Water Board and Regional Water Boards conduct physical, chemical, and biological monitoring of the waters of the state and prepare a(n) biennial assessment report for USEPA (SWRCB, 2012a).

California's CWA Section 303(d) (CWA 303d) Listing Policy sets the rules to identify which waters do not meet water quality standards, even after point source dischargers have installed the required levels of pollution control technology (SWRCB, 2009b). The federal law requires that states establish priority rankings for water on the CWA Section 303(d) list and develop action plans, called Total Maximum Daily Loads (TMDLs) for specific pollutants, to improve water quality and protect designated beneficial uses. TMDLs can take various forms, but most commonly are adopted through the Water Quality Control Plan (Basin Plan) for the Region.

Water bodies are most often listed as impaired for sediment, pathogens, nutrients, increased temperature, pesticides, metals, and organic chemicals. The resulting TMDLs are then implemented through the point

source and NPS regulatory programs, such as the National Pollutant Discharge Elimination System (NPDES) permits for point sources (e.g., wastewater treatment facilities, storm water runoff); State waste discharge requirements (WDRs) for point sources not subject to the NPDES permit program and nonpoint source (NPS) discharges; and/or conditional waivers of WDRs. Additionally, the USEPA and the California Department of Public Health (CDPH) have sanitary survey and source water assessment programs specifically for drinking water sources. Beyond these State and federal efforts, many local agencies, businesses, farmers, non-governmental organizations, and watershed-based groups have implemented pollution monitoring and prevention programs directly on their own, or through partnerships. A more detailed discussion of the legal and regulatory framework for protecting ambient water quality is presented in chapter 3 of volume 1 of the Water Plan Update 2013.

The 2010 California CWA 303(d) List now includes 87,399 impaired river miles and 7,582,984 acres of impaired lakes and Bays. In some cases, a water body is listed for more than one pollutant; in total, there are 3,489 pollutant-water body listings. There have been a total of 1,473 listings addressed to date, 957 of which were addressed by a TMDL and during the 2010 303(d) listing cycle, and 122 de-listings.

Multiple pollutants can be addressed in a single TMDL or multiple water bodies in a watershed may be addressed in a single TMDL. The Regional Water Boards are currently engaged in developing over 181 TMDLs, addressing approximately 255 listings in 2011-12. Schedules have been developed for establishing all required TMDLs over a 13-year period. More detailed schedules of work to be undertaken in the short term have also been developed. The State Water Board TMDL Performance Measure Report Card currently provide the number of TMDLs adopted , number of listings addressed by TMDLs and total number of listings remaining . These Performance Measure Report Cards are updated annually and are available to the public on the State Water Board webpage.

Surface Water Quality

Water quality impairments threaten beneficial uses of surface waters such as domestic use and riparian and aquatic habitats in many parts of the state. In some instances these are major impediments to ecosystem restoration. Urban, military, industrial, hydropower, mining, logging, agriculture, grazing, and recreational activities can potentially degrade water quality. Depleted freshwater flows as a result of upstream dams, diversions, interbasin transfers, and increased urbanization also affect the quality of water downstream, and have public trust doctrine implications. Other water management actions and projects, such as conjunctive use, conveyance, transfers, and conservation, can also affect water quality, both positively and negatively.

On May 4, 2010 the State Water Board adopted a policy for water quality control titled “Policy for Maintaining Instream Flows in Northern California Coastal Streams”. The policy contains principles and guidelines for maintaining instream flows for the purposes of water right administration. The geographic scope of the policy encompasses coastal streams from the Mattole River to San Francisco and coastal streams entering northern San Pablo Bay and extends to five counties: Marin, Sonoma, and portions of Napa, Mendocino, and Humboldt Counties. Office of Administrative Law approval was received on September 22, 2010. A Notice of Decision was filed with the Secretary for Resources on September 28, 2010. The Policy is now in effect. A three-year Predecisional Trial Program has been implemented.

Many significant pollution problems today are the result of persistent “legacy” pollutants, such as

mercury, extracted from the Coastal Range and used to process gold in the Sierra Nevada mines in the 19th century; industrial chemicals such as polychlorinated biphenyls (PCBs), used in electrical transformers; and pesticides such as dichloro-diphenyl-trichloroethane (DDT). These pollutants also contaminate sediments, making ecosystem restoration efforts more difficult. Hydraulic mining during the 1900s still has an adverse impact on numerous Central Valley rivers, major parts of the Klamath River watershed, as well as the San Francisco Bay. Some environmental contaminants of concern, such as mercury, selenium, PCBs, and DDT, are persistent and/or bioaccumulative. Their concentration and toxicity magnify in the food chain and could be toxic to key food chain links, such as aquatic invertebrates, and negatively impact communities and Native American Tribes dependent upon subsistence fisheries. These persistent and/or bioaccumulative contaminants may also have carcinogenic, mutagenic, and teratogenic properties.

Assessments based on USEPA's Environmental Monitoring and Assessment Program (EMAP) for Coastal Waters, and data collected in California from 1999 through 2000 suggest that most of the state's coastal waters appear to be in "fair" to "good" condition. The California Monitoring and Assessment Program (CMAP) data collected in California suggest that approximately 67 to 78 percent of California's wadeable perennial streams statewide are in "Good" condition based on two benthic macroinvertebrate indicators. The CMAP data set does not reliably account for barriers to fish migration, such as those caused by reduced flows or disequilibrium of aggradation/degradation processes. The 2010 California CWA 303(d) List of Water Quality Limited Segments includes water bodies that exceeded established water quality objectives. In some cases, a water body is listed for more than one pollutant; and in total, there are 3,489 pollutant-water body listings. The listings are primarily driven by the lack of attainment or maintenance of water quality to support aquatic organisms. The listing not only assures protection of public water supplies, but also assures the protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife and allows for recreational activities such as swimming, wading, and fishing (40 C.F.R. 125.62). The criteria set to protect aquatic plants and animals are more stringent in most cases than the criteria set to protect human health via drinking water. Exceptions include pollutants which are potential human carcinogens, teratogens, and reproductive toxicants.

On October 22, 2011, the U.S. EPA issued its final decision regarding the water bodies and pollutants added to California's 303(d) Lists and 305(b) Reports, referred to as the 2010 Integrated Report. This replaces the 2006 California Clean Water Act 303(d) List as California's current 303(d) List. The new 2010 Integrated Report is available on a new State Water Board website that enables users to easily search and view water quality assessment information about specific water bodies in California.

The California Water Quality Monitoring Council seeks to provide multiple perspectives on water quality information and to highlight existing data gaps and inconsistencies in data collection and interpretation, thereby identifying areas for needed improvement in order to better address the public's questions. A new set of "My Water Quality" portals, supported by a wide variety of public and private organizations, presents California water quality monitoring data and assessment information that may be viewed across space and time. Initial web portal development concentrates on these areas, with web portals being released one at a time. These portals include: Is Our Water Safe To Drink ?, Is It Safe To Swim In Our Waters ?, Is It Safe to Eat Fish and Shellfish From Our Waters ?, Are Our Aquatic Ecosystems Healthy ? and What Stressors and Process Affect Our Water Quality? The first three web portals are currently live and available to the public, and the final portal is in development.

Groundwater Quality

Human activities increase the discharge of salt and other pollutants to land. Such activities include the application of fertilizers (even at accepted optimal agronomic rates), application of imported water for irrigation containing dissolved salts, and industrial, municipal, and domestic wastewater discharges.

Salts are leached to underlying groundwater by rainfall or irrigation practices. Additionally, salts in native soils can be dissolved by irrigation water and leached to groundwater. For additional discussion see Chapter 18 on Salt and Salinity Management.

Use of nitrogen fertilizers and discharges from onsite wastewater treatment systems and septic tank systems often results in nitrate concentrations in groundwater that exceed drinking water standards. Nitrate in groundwater has resulted in the closure of more public water wells statewide than any other contaminant. Nitrate from agricultural fertilizer is the largest threat to groundwater quality in California, particularly in the Central Valley growing areas. Wellhead treatment programs and blending with higher quality water both are effective at protecting public supply well water quality. However, both can be costly, particularly for lower income communities. Domestic wells are also often at risk from nitrate contamination. Testing is not required of domestic wells, unlike public supply wells, so domestic well owners are typically not aware of the quality of the water they consume. For additional discussion, see Chapter 15 on Groundwater and Aquifer Remediation.

Recharge areas are those areas that provide the primary means of replenishing groundwater. Good natural recharge areas are those where good quality surface water is able to percolate unimpeded to groundwater. If recharge areas cease functioning properly, there may not be sufficient groundwater for storage or future use. Protection of recharge areas requires a number of actions based on two primary goals. These goals are (1) ensuring that areas suitable for recharge continue to be capable of adequate recharge rather than covered by urban infrastructure, such as buildings and roads; and, (2) preventing pollutants from entering groundwater in order to avoid expensive treatment that may be needed prior to potable, agricultural, or industrial beneficial uses.

Protection of recharge areas is necessary if the quantity and quality of groundwater in the aquifer are to be maintained. However, protecting recharge areas by itself does not provide a supply of water. Recharge areas only function when aquifer storage capacity is available, and when regional and local governments and agencies work together to protect or secure an adequate supply of good quality water to recharge the aquifer. Climate change may alter precipitation and runoff patterns which will impact groundwater recharge (see Climate Change section). Protecting existing and potential recharge areas allows them to serve as valuable components of a conjunctive management and groundwater storage strategy.

Zoning can play a major role in recharge areas' protection by amending land-use practices so that existing recharge sites are retained as recharge areas. Some areas that would provide good rates of recharge have been paved over or built upon and are no longer available to recharge the aquifer. Local governments often lack a clear understanding of recharge areas and the need to protect those areas from development or contamination. Land use zoning staff does not always recognize the need for recharge area protection for water quantity and water quality. For further discussion, see Chapter 25, Recharge Areas Protection.

The Groundwater Ambient Monitoring and Assessment (GAMA) Program was created by the State

Water Board in 2000. It was later expanded by Assembly Bill 599 – the Groundwater Quality Monitoring Act of 2001. The main goals of GAMA are: to improve statewide groundwater monitoring and increase the availability of groundwater quality information to the public.

There are four active GAMA projects:

- Priority Basin Project (updated 7/16/10)
- Domestic Well Project
- Special Studies Project
- GeoTracker GAMA

Major groundwater supply basins are a specific focus of the GAMA program. The legislatively mandated program (AB 599) is funded by Proposition 50 and from special fund fees.

The GAMA Program is California's comprehensive groundwater quality monitoring program. GAMA collects data by testing the untreated, raw water in different types of wells for naturally-occurring and man-made chemicals. GAMA compiles these test results with existing groundwater quality data from several agencies into a publicly-accessible internet database, GeoTracker GAMA. Over 95 percent of Californians get their drinking water from a public or municipal source - these supplies are typically treated to ensure that the water is safe to drink.

Using CDPH data, there are an estimated 1.69 million residents in California that are served either by the estimated 600,000 private domestic wells or by community water systems serving fewer than 15 service connections. The CDPH does not regulate the quality of water from these sources. Those served by public or municipal supplies should be concerned about groundwater quality too. About 40 percent of Californians rely on groundwater for a portion of their drinking water. Contaminated groundwater results in treatment costs, well closures, and new well construction which increases costs for consumers. A large portion of California is in a semi-arid climate. Clean water is critical for society and the environment, and also helps sustain business, industry, and agriculture.

Land Use Categories and Pollution Prevention

The State NPS Program addresses NPS pollution by promoting management measures (MMs) and management practices (MPs) for each of the six separate land use categories: agriculture, urban, forestry (silviculture), marinas and recreational boating, hydromodification, and wetlands. Management measures serve as general goals for the control and prevention of polluted runoff. Site-specific MPs are then used to achieve the goals of each management measure. Management practices refer to specific technologies, processes, siting criteria, operating methods or other alternatives to control NPS pollution.

State Water Board and Regional Water Boards and CCC have developed and adopted successive, five-year plans (NPS Implementation Plans) to implement the NPS Program Strategy. The NPS Strategy focuses on the progress made in the NPS Program thus far, describes the additional regulatory, educational, and financial tools made available to the Regional Water Boards, and identifies the need for prioritizing resources and efforts. The goals of the current NPS Implementation Plan are similar to those of the past five-year plans, with a closer focus on the following activities:

- Implementing the Policy for the Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Implementation and Enforcement Policy) by the Regional

Water Boards, particularly through the Regional Water Boards use of regulatory tools;

- Concentrating NPS resources on TMDL planning, assessment and implementation priorities, and shifting these funds away from pollution prevention outreach;
- Improve coordination and leveraging of resources with other funding organizations such as: USDA (EQIP), State Water Board CWSRF, Department of Conservation (Watershed Program Grants), Department of Water Resources (IRWM) and others;
- Focusing overall efforts and resources on high priority watersheds and problems, as defined by priority TMDLs and other region-specific problems; and
- Acknowledging the balancing act required by State Water Board programs to both clean up waters polluted by nonpoint sources and preserve clean waters.

In the next five years the State Water Board expects to have a fully integrated database of existing and tested management measures and management practices, many success stories based on proper implementation and maintenance of these measures and practices, well-established cleanup programs based on actions taken pursuant to the NPS Implementation and Enforcement Policy, and an accurate assessment of the remaining NPS pollution problems in the state. The NPS Program Strategy will be updated by the State Water Board NPS Program after receiving new U.S. EPA Program Plan guidance, which is due out in the Fall of 2012. The goal of this new guidance is to ensure a more cohesive and consistent set of NPS Strategies and reporting requirements for all states. At this time, the State Water Board will be well-positioned to take another long-term look at the future of NPS pollution cleanup priorities.

The State Water Board has developed the NPS Encyclopedia to help practitioners choose management practices for implementation. It is a free online reference guide designed to facilitate a basic understanding of NPS pollution control and to provide quick access to essential information from a variety of sources. This is done through hyperlinks to other resources available on the worldwide web. The purpose of the NPS Encyclopedia is to support the implementation and development of the NPS aspects of TMDLs and watershed action plans with a goal of protecting high quality waters and restoring impaired waters. The companion tool, the NPS MP Miner, allows users to cull data from studies of management practices, peer reviewed and otherwise, by filtering studies using relevant site-specific variables, such as land use category, pollutant of concern, and removal efficiency required. Both tools are available at the State Water Board Web site (SWRCB, 2009d).

Agriculture

Agricultural activities that cause NPS pollution can include poorly located or managed animal feeding operations; overgrazing; plowing too often or at the wrong time; and improper, excessive, or poorly timed application of pesticides, irrigation water, and fertilizer. Farm and ranching pollutants include sediment, nutrients, pathogens, pesticides, metals and salts. To control NPS pollutants generated from this land use category, agricultural MMs address: (1) erosion and sediment control; (2) facility wastewater and runoff from confined animal facilities; (3) nutrient management; (4) pesticide application; (5) grazing management; and (6) irrigation water management and (7) education and outreach.

Urban

Controlling polluted runoff in urban areas is a challenge. Negative impacts of urbanization on coastal and

estuarine waters are well documented in a number of publications, including California's CWA Section 305(b) and Section 303(d) reports and the Nationwide Urban Runoff Program. Major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, road salts, heavy metals, petroleum hydrocarbons, plastics, pesticides, pathogenic bacteria, and viruses. In addition to organic carbon and pathogens such as Giardia and Cryptosporidium, suspended sediments constitute the largest mass of pollutant loadings from urban areas into receiving waters. Construction is a major source of sediment erosion. Petroleum hydrocarbons result mostly from automobile sources. Plastics (including plastic bags and bottles) are mainly the result of urban runoff. Nutrient and bacterial sources include garden fertilizers, leaves, grass clippings, pet wastes, homeless encampments, and faulty septic tanks. As population densities increase, a corresponding increase occurs in trash and pollutant loadings generated from human activities. Many of these pollutants enter surface waters via runoff without undergoing treatment. To control NPS pollutants generated from this land use category, urban MMs address: (1) runoff from developing areas; (2) runoff from construction sites; (3) runoff from existing development; (4) septic tank systems; (5) transportation development (roads, highways, and bridges) and (6) education and outreach.

Forestry (Silviculture)

Silviculture can contribute pollution to rivers and lakes in California. Without adequate controls, forestry operations may degrade the characteristics of waters that receive drainage from forest lands. Sediment concentrations can increase due to accelerated erosion, water temperatures can increase due to removal of over-story riparian shade, dissolved oxygen can be depleted due to the accumulation of slash and other organic debris, and concentrations of organic and inorganic chemicals can increase due to harvesting, fertilizers, and pesticides. To control NPS pollutants generated from this land use category, forestry MMs address: (1) preharvest planning; (2) streamside management areas; (3) road construction/reconstruction; (4) road management; (5) timber harvesting; (6) site preparation/forest regeneration; (7) fire management; (8) revegetation of disturbed areas; (9) forest chemical applications; (10) wetland forest management; (11) postharvest evaluation and (12) education and outreach.

Marinas and Recreational Boating

Recreational boating and marinas are increasingly popular uses of coastal areas and inland surface water bodies (e.g., lakes and San Francisco Bay-Delta), and an important means of public access to navigable waterways. Therefore, California must balance the need for protecting the environment and the need to provide adequate public access. Because marinas and boats are located at the water's edge, pollutants generated from these sources are less likely to be buffered or filtered by natural processes. When boating and adjunct activities (e.g., those that take place at marinas and boat maintenance areas) are poorly planned or managed, they may pose a threat to water quality and the health of aquatic systems.

Water quality issues associated with marinas and recreational boating include:

- Poorly flushed waterways
- Pollutants discharged from the normal operation of boats (recreational boats, commercial boats, and "live-aboards")
- Pollutants carried in storm water runoff from marinas, ramps, and related facilities
- Physical alteration of wetlands and of shellfish/other benthic communities during construction of marinas, ramps, and related facilities

- Pollutants generated from boat maintenance activities on land and in the water.
- Dredging in marinas and boat maintenance areas.
- Introductions of aquatic invasive species, both plant and animal, that degrade water quality, ecosystem processes, and water infrastructure.

Common pollutants generated from marinas and recreational boating activities include: copper, bacteria and pathogens, nutrients, aquatic and invasive species such as quagga mussels and Caulerpa taxifolia, and oil and grease. To control NPS pollutants generated from this land use category, marina and recreational boating MMs include: (1) marina facility assessment, siting, and design – water quality assessment, marina flushing, habitat assessment, shoreline stabilization, storm water runoff, fueling station design, sewage facilities, and waste management facilities,(2) operation and maintenance – solid waste control, fish waste control, liquid material control, petroleum control, boat cleaning and maintenance, sewage facility maintenance, and boat operations and (3) education and outreach.

Hydromodification

Hydromodifications that can impair water quality include: channel modification (channelization), flow alterations, levees, and dams. Channel modification activities are undertaken in rivers or streams to straighten, enlarge, deepen, or relocate the channel. These activities can affect water temperature, change the natural supply of fresh water to a water body, and alter rates and paths of sediment erosion, transport, and deposition. Hardening the banks of waterways with shoreline protection or armor also accelerates the movement of surface water and pollutants from the upper reaches of watersheds into coastal waters. Channelization can also reduce the suitability of instream and streamside habitat for fish and wildlife by depriving wetlands and estuarine shorelines of beneficially-enriching sediments, affecting the ability of natural systems to filter pollutants, and interrupting the life stages of aquatic organisms. Dams can adversely impact hydrology and the quality of surface waters and riparian habitat in the waterways where the dams are located. A variety of impacts can result from the siting, construction, and operation of these facilities. For example, improper siting of dams can inundate both upstream and downstream areas of a waterway. Dams reduce downstream flows, thus depriving wetlands and riparian areas of water. During dam construction or dredging, removal of vegetation and disturbance of underlying sediments can increase turbidity and cause excessive sedimentation in the waterway. Further, metered flows from dams fail to exert the forces that build and maintain channel structure and beneficial floodplain functions.

The erosion of shorelines and streambanks is a natural process that can have either beneficial or adverse impacts on riparian habitat. Excessively high sediment loads resulting from erosion can smother submerged aquatic vegetation, cover shellfish beds and tidal flats, fill in riffle pools, and contribute to increased levels of turbidity and nutrients (USEPA, 2009a). To control NPS pollutants generated from this land use category, hydromodification MMs address: (1) channelization-channel modification; (2) dam construction and operation – erosion and sediment control and chemical pollutant control issues, and the downstream impact of reservoir releases on riparian habitat; (3) streambank and shoreline erosion control and (4) education and outreach.

Wetlands

Wetlands and riparian areas reduce polluted runoff and enhance water quality by filtering out runoff-related contaminants, such as fine-grained sediment, nutrients (nitrogen and phosphorus), and some

metals. Functional wetlands and riparian systems provide other services such as surface and groundwater storage, flood control (with adequate set-backs), and storm surge attenuation. They also support valuable wildlife and aquatic habitats. Highly modified wetlands and riparian systems are typically managed for a few beneficial uses or services, are costly to maintain, and have questionable long-term sustainability. Natural wetlands are self-sustaining when not adversely impacted by pollution.

Changes in hydrology, soil texture, water quantity, and/or species composition can impair the ability of wetland or riparian areas to filter out excess sediment and nutrients and therefore can result in deteriorated water quality. Wetlands and riparian areas may be impacted or destroyed by construction, filling, or other alterations. Historically, significant losses of wetlands have been caused by draining wetland soils for conversion to croplands, or dredging wetland soils for waterway navigation. Spongy wetland soils are compacted by over-grazing and grading. Loss of wetland acreage increases polluted runoff, leading to degradation of surface water quality.

To control NPS pollutants generated from this land use category, wetlands MMs address: (1) protection of wetlands and riparian areas, (2) restoration of wetlands and riparian areas, (3) vegetated treatment systems and (4) education and outreach.

Major Issues Facing Pollution Prevention

Irrigated Agriculture

Agricultural discharges including irrigation return flow, flows from tile drains, and storm water runoff affect water quality by transporting pollutants such as pesticides, sediments, nutrients, salts (including selenium and boron), pathogens, and heavy metals from cultivated fields into surface waters. Many surface water bodies are impaired because of pollutants from agricultural sources. Groundwater bodies have also suffered pesticide, nitrate, and salt contamination. Statewide, approximately 11,796 miles of rivers/streams and some 488,457 acres of lakes/reservoirs are listed on the state's impaired waters list as being impaired by runoff from irrigated agriculture. Of these, approximately 1,700 miles, or approximately 15%, have been identified as impaired by pesticides.

The Irrigated Lands Regulatory Program (ILRP) regulates discharges from irrigated agricultural lands. Its purpose is to prevent agricultural discharges from impairing the waters that receive the discharges. To protect these waters, Regional Water Boards have issued conditional waivers of waste discharge requirements to growers that contain conditions requiring water quality monitoring of receiving waters and corrective actions when impairments are found.

To control and assess the effects of discharges from irrigated agricultural lands and implement TMDLs, the Central Coast, Central Valley, Los Angeles, and San Diego Regional Water Boards have adopted comprehensive conditional waivers of waste discharge requirements (WDRs). Growers must comply with the conditions of the waiver in order to avoid direct regulation through issuance of individual WDRs. The Colorado River Basin Regional Water Board had previously adopted a Conditional Prohibition as a TMDL implementation plan incorporated into their Basin Plan to regulate irrigated agriculture. Currently they are in the process of creating a Conditional Waiver. The San Francisco Bay Regional Water Board staff is developing a Conditional Waiver of Waste Discharge Requirements for Vineyard Facilities in the

Napa River and Sonoma Creek Watersheds (Vineyard Waiver) and is expected to complete public review drafts of the Vineyard Waiver and accompanying environmental documents in the Spring of 2012. The North Coast Regional Water Quality Control Board is developing a Water Quality Compliance Program for Discharges from Irrigated Lands to address water quality impacts associated with irrigated agricultural lands in the North Coast Region.

An estimated 40,000 growers, who cultivate over 7 million acres, are subject to Regional Water Board irrigated agriculture regulatory programs in these regions. These Regional Water Boards have made significant strides to implement their irrigated agriculture regulatory programs and are committed to continue their efforts to work with the agricultural community to protect and improve water quality.

Confined Animal Facilities

California has approximately 1,700 dairies with an average size of about 800 milk cows. There are also several hundred feedlots, poultry operations, and other animal feeding operations (AFOs) in the state. California regulations refer to these operations, including concentrated animal feeding operations (CAFOs), as "confined animal facilities" (CAFs). The exact number of facilities in California that are large or medium CAFOs based on animal populations is unknown, but is estimated at between 1,000 and 1,200.

Most of the commercial CAFs are within the jurisdiction of the Central Valley Regional Water Board, including over 80 percent of the dairies. There are also about 140 dairies and feedlots in the Santa Ana Region, and about 200 dairies (mostly smaller facilities with less than 300 milk cows) in the North Coast and San Francisco Bay Regions. Each Regional Water Board develops its own regulatory program for CAFs.

Dairies and feedlots in the Santa Ana Region and in the Colorado River Basin operate under general NPDES permits that require preparation of an engineered waste management plan. Most dairies in the Central Valley Region are regulated under General Waste Discharge Requirements (WDR) Order No. R5-2007-0035, but some are under an individual WDR order or another general order. In March 2012, the North Coast Regional Water Board adopted a general WDR Order, a general NPDES permit, and a waiver program to regulate dairies in that region. Other regions use individual WDR orders or waivers to regulate their AFOs.

The permitted facilities pay an annual fee that is based on animal population and ranges from $357 to over $7,000 plus a surcharge to support the State Water Board's Surface Water Ambient Monitoring Program (SWAMP). Most of the WDR orders require the dairies to develop and implement nutrient management plans and to submit annual reports. In the Central Valley Region, dairies are also required to test on-site wells and to monitor groundwater, either individually or as part of a coalition.

Urban Impacts

Urban storm water runoff washes pollutants such as nutrients (lawn fertilizers and pet wastes), sediment, oxygen-demanding substances, roads salts, pesticides, oil and grease, heavy metals, organic chemicals, human pathogens, petroleum hydrocarbons, and debris (especially plastics and plastic particulates) from city streets and other hard surfaces into surface waters (including beaches). Suspended sediments

constitute the largest mass of pollutant loadings to receiving waters from urban areas. Construction is a major source of sediment erosion. Petroleum hydrocarbons result mostly from automobile sources. Nutrient and bacterial sources include garden fertilizers, leaves, grass clippings, pet wastes, and faulty septic tanks. As population densities increase, a corresponding increase occurs in pollutant loadings generated from human activities. Many of these pollutants enter surface waters via runoff without undergoing treatment.

Urban runoff management requires that several objectives be pursued simultaneously. These objectives include the following (American Public Works Association, 1981):

- • Protection and restoration of surface waters by the minimization of pollutant loadings and negative impacts resulting from urbanization;
- • Protection of environmental quality and social well-being;
- • Protection of natural resources, e.g., wetlands and other important aquatic and terrestrial
- ecosystems;
- • Minimization of soil erosion and sedimentation problems;
- • Maintenance of the predevelopment hydrologic conditions;
- • Protection of ground water resources;
- • Control and management of runoff to reduce or prevent flooding; and
- • Management of aquatic and riparian resources for active and passive recreation.

Natural Impacts and Legacy Pollutants

Arsenic, asbestos, radon, minerals, and sometimes microbes and sediment are examples of naturally occurring contaminants for which a pollution prevention approach is infeasible. Furthermore, some contaminants that are of concern specifically for drinking water, such as organic carbon from watershed runoff, and bromide—a component of ocean salinity, are a result of natural processes for which a pollution prevention approach is not possible. While there are natural sources of organic carbon, agriculture drainage, urban runoff, and wastewater discharges typically contain higher concentrations than natural runoff.

Abandoned mines and former industrial and commercial sites, such as gas stations and dry cleaning operations, often leave behind contamination problems without a clear link to any legally responsible or financially viable party or entity to pay for cleanup. The State and federal governments and potentially responsible parties often wind up in extensive regulatory and legal proceedings determining legal and financial responsibility while the contaminants remain, perhaps continuing to migrate off-site.

Emerging Issues

Traditionally, water agencies focus on pathogens (disease-causing microorganisms), chemicals, and disinfectant byproducts (potential cancer-causing contaminants), that are regulated or will be regulated in the near future. Recently, though, other unregulated chemicals and pollutants are being discovered to have unexpected health and environmental effects. Chemicals found in pharmaceuticals and personal care products (PPCPs), byproducts of fires and fire suppression, and discarded elements of nanotechnology are emerging as actual or potential water contaminants. Air deposition of a whole host of pollutants is now seen as a significant contributor to water pollution. Some of these emerging pollutants have not yet been subject to rigorous assessment or regulatory action. Although California has not established state-wide standards or effluent limits for unregulated compounds including pharmaceuticals or emerging

contaminants, and absent of federal- or state-established numeric standards, the state has a mechanism for establishing site-specific discharge effluent limits and/or receiving water NPDES permit limitation. Each Regional Water Board in California has a water quality control plan or Basin Plan that presents the water quality objectives and criteria for surface and groundwater for the region. These water quality objectives may be narrative or numeric. Narrative water quality objectives take into consideration concerns such as nuisance and toxicity that may adversely affect beneficial uses of surface and groundwater. For example, the narrative water quality objective for toxicity is "All water shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal or aquatic life." To address the narrative water quality objective, a site-specific, numeric effluent limitation for a compound may be established based on readily available information for the discharge and studies on human and environmental effects.

Institutional barriers can contribute to the difficulty of addressing pollution from uncontrolled runoff, especially as the State moves towards a broader watershed approach to pollution prevention and regulatory action. Various State, local and federal agencies have divided jurisdiction over groundwater versus surface waters, polluted runoff versus point source discharges, water quantity versus water quality issues, and even over monitoring and assessing pollutants. These various "stovepipes" of regulatory authority can hamper the more holistic watershed approach to water quality management, and will need to be addressed in the coming years. Management and regulation of water quality in California is fragmented among at least eight State and federal agencies, with no one agency looking after water quality from source to tap. For example, the State Water Board and Regional Water Boards regulate ambient water quality, while the California Department of Public Health (CDPH) primarily regulates treatment and distribution of potable water. Further, surface water storage and conveyance in California is mostly managed by the Department of Water Resources and the US Bureau of Reclamation, while groundwater is usually not managed in a coordinated manner at all. Moreover, serving drinking water to Californians is an obligation of cities, water districts, and private water companies that were generally not formed in any comprehensive pattern.

Efforts to coordinate, collaborate and leverage various agency authorities towards improvements of water quality in California have been initiated and will need to continue in order to alleviate these institutional barriers. The State Water Board is preparing an amendment to the Recycled Water Policy to include monitoring requirements for constituents of emerging concern (CECs) in recycled water for indirect potable reuse (groundwater recharge of a drinking water aquifer). To assess the aquatic life impacts of pharmaceutical discharges, the State has recently contracted for research in development and evaluation of bioanalytical screening or bioassay techniques for potential application in recycled water monitoring.

The goal is to develop high throughput bioassays for the screening of compounds for specific biological target activities (e.g., endocrine disruption, etc.).

Finally, the diffuse nature of NPS pollution and the need to control sources on private and public land adds to the difficulties of instituting pollution prevention measures.

Climate Change

Pollution Prevention (RMS 17)

Climate Change

Climate change may exacerbate concentrations of pollutants in rivers and lakes from multiple sources. Higher temperatures will cause more algal blooms, reducing dissolved oxygen levels and decreased filtering capacity. Storm events following forest fires may result in increased desposition of pollutants in waterways. Also, pesticide application may increase as more pests survive warmer and drier winter conditions. . In the urban environment,the projected stronger storms may also overwhelm urban stormwater systems, leading to additional dispersion of pollutants urban waterways.

Adaptation

New standards for land use and development, such as fewer impervious surfaces, more onsite use of rainwater, and more vegetated areas should reduce the amount of pollution in populated areas. Forest management techniques, such as small biomass removal, and integrated pest management practices can also reduce the likelihood of catastrophic fires and increased pesticide use to combat pest infestations. Another adaptation measure may include higher levels of treatment for discharges into rivers and lakes. In the agricultural sector, reduced application of nitrogen-based fertilizers could advance adaptation by keeping groundwater aquifer water quality adequate for use.

Mitigation

Vehicles are one of the major mobile (non-point) sources of pollution. Shifts to reduce vehicle use and away from gasoline-fueled vehicles may reduce the volume of pollutants entering waterways. Fewer pollutants could result in reduced water treatment needs, which would mean less energy usage and fewer GHG emissions. Increased regulation of stationary sources of pollution may result in higher energy usage for treatment, but could provide water quality benefits that mean less treatment before use or discharge.

~~Mitigation~~

~~Content is under development.~~

~~Adaptation~~

~~It is widely recognized that changes in temperature and precipitation patterns will impact water availability and quality. Higher air temperatures lead to increases in water demand and changes in hydrologic conditions, resulting in drought and greater threats of wildfires, and reduced snowpack, earlier snowmelt, and a rise in sea level that may cause more seawater intrusion which will in turn affect low-lying coastal infrastructure. Also, higher water temperatures reduce dissolved oxygen levels, which can have an adverse effect on aquatic life. Where river and lake levels fall, there will be less dilution of pollutants; however, increased frequency and intensity of rainfall will produce more pollution and sedimentation due to runoff. In addition, more frequent and intense rainfall may overwhelm pollution~~

~~control facilities that have been designed to handle sewage and storm water runoff under assumptions anchored in historical rainfall patterns.~~

~~Water quality impairments are especially critical as droughts and expected increases in the impacts of climate change further limit water supplies. Changes in hydrology, such as reduced snow pack and earlier snowmelt, result in less natural water storage and more difficulties managing reservoirs and reservoir releases to maintain river temperatures that are cool enough for anadromous fish. Moreover, lower groundwater tables resulting from less recharge and/or more extractions can reduce or eliminate base flow in creeks, severely affecting aquatic habitat, as well as lead to catastrophic subsidence. The condition of California's fish populations reveals the need for action. Currently, 34 fish species are listed as threatened or endangered in California, including coastal and Central Valley runs of steelhead, spring-run and winter-run Central Valley Chinook salmon, a central coast population of Coho salmon, Delta smelt, three species from the Colorado River, and several species from the Klamath Basin and southern deserts. Consequently, to ensure a reliable water supply and adequate aquatic habitat, California must manage water in ways that protect water supply and protect and restore the environment.~~

~~The State Water Board has committed to enhancing and encouraging sustainability within the administration of Water Board programs and activities by promoting water management strategies such as low impact development, considering the impacts of climate change in our decision-making, and coordinating with governmental, non-profit, and private industry and business partners to further strategies for sustainability.~~

Monitoring and Assessment

California Senate Bill 1070 was enacted to better orchestrate the many water quality monitoring efforts already in progress within the state, and to make that process more visible to the user population and to the entities committed to the protection, monitoring and supply of water to all its users. It provides for the creation of a structure to allow the public to access any available water quality data, current methods and research, as well as current regulations and enforcement actions. The bill also creates a California Water Quality Monitoring Council (CWQMC) to connect the myriad activities throughout the state in a more cohesive and sensible manner, with the ability to provide direction to reduce redundancies, prioritize actions and recommend funding necessary to give the critical information necessary to protect California's water. This bill specifically addresses Recommendation 3 of the California Water Plan Update of 2005.

The Surface Water Ambient Monitoring Program (SWAMP) is a statewide monitoring effort that provides the scientifically sound data we need to effectively manage California's water resources. "Ambient" monitoring refers to the collection of information about the status of the physical, chemical and biological characteristics of the environment. The State Water Board and the Regional Water Boards introduced SWAMP in 2001. The program's purpose is to monitor and assess water quality to determine whether we are meeting water quality standards and protecting beneficial uses. Data from SWAMP are used to improve the state's water quality assessment and impaired water bodies list, required under CWA Sections 305(b) and 303(d), respectively.

The Central Coast Ambient Monitoring Program (CCAMP) is the Central Coast's regional component of SWAMP. CCAMP plays a key role in assessing Central Coast regional goals and has a number of

program objectives: (1) assess watershed condition on a five-year rotational basis, using multiple indicators of health; (2) assess long-term water quality trends at the lower ends of coastal creeks; (3) conduct periodic assessments of harbors, estuaries, lakes, and near-shore waters using multiple indicators of health; and (4) support investigations of other water quality problems, including emerging contaminants, sea otter health, pathogenic disease, toxic algal blooms and others.

In 2004, California Monitoring and Assessment Program (CMAP) for wadeable perennial streams was initiated. This program builds on USEPA's Environmental Monitoring and Assessment Program using a probabilistic monitoring design incorporating land use classes to allow for assessments of status and trends in aquatic life beneficial use protection in streams. Historic EMAP data were analyzed to produce assessments of the condition of streams statewide and in special study areas in northern and southern coastal California. Several assessments will also be completed focusing on providing water quality information statewide, and for the broad land use categories such as urban, agriculture, and forested areas. Based upon the highly extrapolative nature of this program, practitioners with intimate familiarity with specific water body conditions have questioned the sensitivity of this approach to identifying barriers to migration, which cause impairment to anadromous fish populations in water bodies displaying generally good water quality. These efforts directly relate to recommendation 3 of this strategy in the 2005 California Water Plan and can be seen as some success in responding to this recommendation.

CMAP conducted a sampling effort in 2007. The Perennial Streams Survey was initiated in 2008. This effort, and expansion of CMAP, is aimed at developing a coordinated and comprehensive statewide monitoring design that would integrate bioassessment efforts currently funded through the State's SWAMP and the NPS Programs with existing local and regional bioassessment efforts. A key feature of the design would be to identify relationships between land-use stressors and response.

Wastewater Infrastructure Needs

While great strides have been made in providing treatment of wastewater before discharge to surface waters, much of the wastewater treatment infrastructure has exceeded its useful life expectancy. Without continued upgrade and replacement, the failure rates of wastewater treatment facilities could increase, thereby degrading the surface waters that receive the effluent from these facilities.

With changes in streamflow patterns predicted with climate change, the historic assimilative capacity of streams with respect to wastewater discharges would need to be re-evaluated. Treatment processes may need to be upgraded to more advanced levels. In addition, advances in our knowledge of the impacts of emerging contaminants may necessitate more implementation of more advanced treatment processes.

Onsite Wastewater Treatment Systems (OWTS)

The use of Onsite Wastewater Treatment Systems (OWTS), including septic tanks and leachfields, can be an effective means of treating and disposing of domestic wastewater. However, improper siting of OWTS and other factors can lead to public health and environmental impacts, including direct human exposure to domestic waste and degradation of ground water and surface water quality. To address these issues, Assembly Bill (AB) 885 (Wat. Code § 13290) was passed by the California State Legislature and signed into law in September 2000. Under AB 885, the State Water Board is required to adopt regulations or standards for the operation of OWTS. The State Water Board has drafted a new policy to meet this legal

mandate. The new policy was adopted by the State Water Board in June 2012. The policy is designed to ensure that surface waters and ground waters are not contaminated by septic systems and waters in California are safe for beneficial uses.

Costs Associated with Pollution Prevention

The 2012 Clean Water Needs Survey (CWNS) official data collection period began January 9, 2012 and will continue through the October 26, 2012 data submittal deadline. January through December 2012, USEPA will be reviewing data provided by the states. USEPA will host a CWNS 2012 End of Survey Meeting in Washington, DC in the spring of 2013. USEPA will deliver the CWNS 2012 Report to Congress and provide data to the public via the USEPA website in late 2013.

According to the 2008 USEPA CWNS, California has more than $21 billion of needs to prevent both point source and NPS pollution. (USEPA, 2009b) This survey, though, emphasized point source discharges, which represented more than $20 billion of the needs, and likely underestimated the cost of measures to adequately prevent NPS pollution. An assessment of water quality conditions in California shows that NPS pollution has the greatest effect on water quality. It affects some of the largest economic segments of the state's economy, from agricultural development and management to the tourist industry. As previously discussed, nonpoint sources are not readily controlled by conventional means. Instead, they are controlled with preventive plans and practices used by those directly involved in those activities and by those overseeing such activities. The following examples provide some insight into the complexity and costs associated with NPS pollution prevention in California.

Clean Beaches

Runoff from urban areas can contain heavy metals, pesticides, petroleum hydrocarbons, trash, plastics and animal and human waste.(Heal the Bay, 2009) This urban runoff can have a detrimental impact on one of California's greatest natural and economic resources, its world-renowned beaches. This natural resource attracts millions of tourists and locals alike each year. The direct revenues generated by the California beach economy amounted to nearly $12 billion in 2004. (NOEP, 2009) Unfortunately, runoff from creeks, rivers, and storm drains creates the largest source of water pollution for the beaches. Often the currents in the bays, around offshore islands, and along sections of the coast can exacerbate pollution by trapping or directing pollutant to a particular area along the coast. Some stretches of beaches in Southern California are permanently posted by local health departments as unsafe for swimming and surfing, or periodically posted after storm events. It is recommended that no one swim in the ocean during and for at least three days after a significant rain event because of contaminated urban storm water runoff draining directly into the ocean. During dry weather, California beaches experience much better water quality, although sewer spills that result in beach closures and other sources of pollution exist year-round.

In response to protecting the state's beach resources, the governor identified $32.3 million of grant funding in the 2001 state budget to help fund the Clean Beaches Initiative (CBI). The water quality goal of the CBI is to make beaches safe for recreational ocean water contact. The projects being funded through the CBI include storm water diversions to wastewater treatment plants, storm water treatment systems, the implementation of best management practices that reduce the amount of urban runoff reaching the beaches, and source identification studies to identify potential projects. Since 2001, the CBI

program has funded approximately 97 projects totaling about $92 million. In addition, $37 million of Prop. 84 funds has been allocated to the CBI program and will be available for projects through 2013. The beaches are located from the Monterey Bay (Pacific Grove) to just north of the US-Mexico border (Imperial Beach).

Diverting storm water away from Southern California beaches has historically cost approximately $500,000 to more than $1 million per project. However, such diversions are extremely effective in reducing bacterial levels in the water, as well as other pollutants associated with urban runoff. A success story is the Santa Monica Bay beaches in Los Angeles County. Some beaches on the bay were either permanently posted or regularly posted until many of the storm water drains were diverted to a nearby wastewater treatment facility. After the diversions, beaches near the Santa Monica Pier are now off the permanently posted list and are only rarely posted. The beaches on the bay can get well over a million visitors over the course of a summer weekend. This level of visitation implies a high level of direct and indirect economic benefits gained by the beach community and high indirect economic benefits experienced by surrounding areas.

California beaches are an important environmental and economic resource for the state and the Nation. Efforts such as the CBI to fund storm water diversions and other water quality improvement projects are creating benefits that are likely to far outweigh their costs.

Irrigated Agriculture

Some costs to address NPS pollution control needs associated with agricultural activities are related to croplands, such as plowing, pesticide spraying, irrigation, fertilizing, planting and harvesting. Some examples of management practices (MPs) used to address these needs are conservation tillage, nutrient management, and irrigation water management. Other costs are associated with rangeland management, including rotation, revegetation, and riparian exclosure fencing. *Cost updates to follow.*

Confined Animal Facilities

The permitted facilities pay an annual fee that is based on animal population and ranges from $357 to over $7,000 plus a surcharge to support the State Water Board's Surface Water Ambient Monitoring Program (SWAMP). Most of the WDR orders require the dairies to develop and implement nutrient management plans and to submit annual reports. In the Central Valley Region, dairies are also required to test on-site wells and to monitor groundwater, either individually or as part of a coalition.

Benefits Associated with Pollution Prevention

For the vast majority of contaminants, it is generally accepted that a pollution prevention approach to water quality is more cost-effective than end-of-the-pipe treatment of wastes, or advanced domestic water treatment for drinking water. Pollution prevention measures are usually more cost-effective because they have lower initial capital costs, as well as less ongoing operations and maintenance costs including lower energy needs to clean up polluted water, than traditional engineered treatment systems. By preventing further degradation of water through pollution prevention we see overall improvement of water quality over time in both surface and groundwater. Pollution prevention can be considered in the context of

adaptation, while pollution treatment is generally associated with mitigation.

Pollution prevention activities such as stormwater runoff and low impact development (see the Urban Runoff Management resource management strategy) can reduce or maintain the peak runoff from urbanized areas such that they can meet the channel capacity of the natural system without the need for new manmade protection structures.

Small rural water systems, which generally lack technical and financial capacities, may be more reliant upon pollution prevention measures than other options available to larger systems, such as advanced treatment. When surface water is polluted the only other available source is groundwater. Therefore, preventing pollution of surface water keeps options for water supply open which is especially important in areas where the groundwater resources may already be in overdraft.

By protecting the quality of surface water and near-shore coastal waters this management strategy provides multiple benefits or uses by providing opportunities for water contact recreation, as well as serving as a water source for desalination plants, and maintaining suitable habitat for wildlife.

Recommendations for Pollution Prevention

1. Pollution prevention and management of water quality impairments should be based on a watershed approach. A watershed-based approach adds value, reduces cost, promotes cross-media, and integrates programmatic and regional strategies.
2. The Department of Water Resources should collaborate with the State Water Board to integrate the Basin Plans and other statewide water quality control plans and policies into a comprehensive Water Quality Element of the Water Plan.
3. The CWQMC should include a focus on emerging, unregulated contaminants in order to provide an early warning system of future water quality problems, as well as identify trends in water quality using multiple indicators of health. Drinking water supplies should have outcome-based monitoring, such as bio-monitoring and waterborne disease outbreak surveillance. The proposed Interagency Water Quality Program would be modeled after the existing Interagency Ecological Program. The groundwater portion of this effort should be consistent with the recommendations of the Groundwater Quality Monitoring Act of 2001 and DWR's Bulletin 118, while the surface water aspects should be coordinated with the State Water Board's Surface Water Ambient Monitoring Program.
4. Regional, Tribal, and local governments and agencies should establish drinking water source and wellhead protection programs to shield drinking water sources and groundwater recharge areas from contamination. These source protection programs should then be incorporated into local land use plans and policies.
5. Identify communities that rely on groundwater contaminated by anthropogenic sources as their drinking water source, and take appropriate regulatory or enforcement action against the responsible party. Address improperly destroyed, abandoned, or sealed wells in these communities that may serve as potential pathways for contaminants to reach groundwater.
6. The State should prioritize grant funding for source water protection activities, including building institutional capacity for watershed planning, pollution prevention outreach, and wastewater treatment facilities.

Pollution Prevention in the Water Plan

This is a new heading for Update 2013. If necessary, this section will discuss the ways the resource management strategy is treated in this chapter, in the regional reports and in the sustainability indicators. If the three mentions aren't consistent, the reason for the conflict will be discussed (i.e., the regional reports are emphasizing a different aspect of the strategy). If the three mentions are consistent with each other (or if the strategy isn't discussed in the rest of Update 2013), there is no need for this section to appear.]

References

For Update 2013, the "References" section will have the following subheadings: "References Cited" (for references that have in-text citations), "Additional References" (for additional materials that either the author consulted but did not cite or that readers may appreciate generally), and "Personal Communications" (for personal communications that you have documented using the form for that purpose; if you have not documented such communications, just use attribution in the narrative and do not include an entry in the bibliography). For now, the references provided for Update 2009 have been placed under the "References Cited" subhead. If they are no longer cited in the text after the text has been updated for 2013, place them under the "Additional References" subheading instead or delete them altogether. In general, legal references (statutes, codes, acts, etc.) do not need to be included within this section and can instead be described within the narrative above. Additional guidance on references and citations is contained within California Water Plan Update 2013: Publications Process and Style Guide, *available from volume leads.]*

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